CLAIMS

1. A method of fabricating a microelectromechanical system, said method comprising:

providing a substrate comprising a handle layer of silicon, a device layer of silicon and a sacrificial layer of silicon disposed between said handle layer and said device layer;

forming a micromechanical structure in said device layer; and

removing at least a portion of said sacrificial layer of silicon underlying said micromechanical structure to release said micromechanical structure for movement

2. A method of fabricating a microelectromechanical system, as per claim 1, wherein said silicon of said sacrificial layer is single crystal silicon.

3. A method of fabricating a microelectromechanical system,as per claim 1, wherein said forming step further comprises:

forming an isolation trench that extends through at least said device layer.

4. A method of fabricating a microelectromechanical system, as per claim 1, wherein said handle layer is separated from said sacrificial layer by a first dielectric layer, said sacrificial layer is separated from said device layer by a second dielectric layer, and said forming step further comprises:

forming an isolation trench that extends through at least said sacrificial layer, said isolation trench defining a release area in said sacrificial layer; and

etching said silicon of said device layer to form said micromechanical structure

5. A method of fabricating a microelectromechanical system, as per claim 4, wherein said silicon of said device layer is polysilicon.

6. A method of fabricating a microelectromechanical system, as per claim 4, wherein said silicon of said device layer is single crystal silicon.

7. A method of fabricating a microelectromechanical system, as per claim 4, wherein said isolation trench additionally extends through said device layer.

8. A method of fabricating a microelectromechanical system, as per claim 4, said removing step further comprising:

placing a photoresist layer on top of said device layer over at least said micromechanical structure;

forming release etch holes through said photoresist layer and said second dielectric layer; and

etching said sacrificial layer of silicon underlying said micromechanical structure.

9. A method of fabricating a microelectromechanical system, as per claim 8, wherein said first dielectric layer is used as an etch stop for said etching of said sacrificial layer.

10. A method of fabricating a microelectromechanical system, as per claim 8, wherein said second dielectric layer is used as an etch stop for said etching of said sacrificial layer.

11. A method of fabricating a microelectromechanical system, as per claim 8, wherein said isolation trench is used as an etch stop for said etching of said sacrificial layer.

12. A method of fabricating a microelectromechanical system, as per claim 4, wherein said handle layer has actuation electrodes formed thereon.

13. A method of fabricating a microelectromechanical system, as per claim 12, said forming step further comprising:

forming via posts extending through at least said sacrificial layer to contact said actuation electrodes.

14. A method of fabricating a microelectromechanical system, as per claim 13, wherein said via posts additionally extend through said device layer.

15. A method of fabricating a microelectromechanical system, as per claim 4, wherein actuation electrodes are formed on the bottom of said sacrificial layer.

16. A method of fabricating a microelectromechanical system, as per claim 1, said method further comprising:

bonding a silicon-on-insulator wafer to a handle wafer of silicon to create said substrate.

17. A method of fabricating a microelectromechanical system, as per claim 1, said method further comprising:

bonding a first silicon-on-insulator wafer to a handle wafer of silicon and removing a handle layer of said first silicon on insulator wafer to create said sacrificial layer; and

bonding a second silicon on insulator wafer to said sacrificial layer and removing a handle layer of said second silicon on insulator wafer to create said device layer.

18. A method of fabricating a microelectromechanical system, as per claim 1, said method further comprising:

bonding a first wafer of silicon to a second wafer of silicon;

bonding a third wafer of silicon to said first wafer of silicon; and

whereby said substrate is created.

19. A method of fabricating a microelectromechanical system, as per claim 1, wherein said micromechanical structure is any one of: a micro-optical device, an inertial sensor, or an actuator.

20. A method of fabricating a microelectromechanical system, as per claim 19, wherein said micro-optical device is a micromirror.

21. A method of releasing a micromechanical structure for movement, said micromechanical structure etched in a silicon device layer, said method comprising:

etching a silicon sacrificial layer disposed between said micromechanical structure and a silicon handle layer.

22. A method of releasing a micromechanical structure for movement, as per claim 21, wherein said micromechanical structure is a micromirror.

23. A microfabricated device comprising:

a substrate having a device layer;

a least one micro-optical device etched on said device layer and released for movement by removal of an underlying sacrificial layer of silicon; and

active electronics formed on said device layer.

24. A microfabricated device as per claim 23, wherein said micro-optical device is a micromirror.

25. A microfabricated device as per claim 23, wherein said active electronics are formed via CMOS fabrication techniques.

26. A microfabricated device as per claim 23, wherein said silicon of said device layer is single crystal silicon.

27. A microelectromechanical device comprising:

a handle layer of silicon having actuation electrodes formed thereon;

a device layer of silicon having a micromechanical structure formed thereon; and

a sacrificial layer of silicon disposed between said handle layer and said device layer of silicon, said sacrificial layer of silicon having a portion underlying said micromechanical structure removed to form an actuation cavity below said micromechanical structure.

28. A microelectromechanical device as per claim 27, further comprising:

at least one isolation trench extending through said device layer and said sacrificial layer and enclosing said cavity and micromechanical structure.

29. A microelectromechanical device as per claim 28, wherein said isolation trench is lined with a dielectric and filled with a conductive material.

30. A microelectromechanical device as per claim 29, wherein said dielectric is an oxide and said conductive material is doped polysilicon.

31. A microelectromechanical device as per claim 27, further comprising:

at least one via post extending through said device and said sacrificial layer for electrical connection to said actuation electrodes.

32. A microelectromechanical device as per claim 27, wherein said silicon of said device layer is polysilicon.

33. A microelectromechanical device as per claim 27, wherein said silicon of said device layer is single crystal silicon.

34. A microelectromechanical device as per claim 33, said device further comprising:

integrated electronics formed on said device layer.

35. A microelectromechanical device as per claim 34, wherein said integrated electronics electrically connected to said actuation electrodes by at least one via post extending through said device layer and said sacrificial layer.

36. A microelectromechanical device as per claim 27, wherein said micromechanical structure is a micromirror.

37. A micromirror device comprising:

a substrate having a device layer, a handle layer and a sacrificial layer made of silicon disposed between said device layer and said handle layer;

an isolation trench extending through said device layer and said sacrificial layer, said isolation trench defining a mirror region and electrically isolating said mirror region;

a mirror formed from said device layer in said mirror region above actuation electrodes formed on said handle layer; and

a cavity formed below said mirror by removing a portion of said sacrificial layer of silicon.

38. A micromirror device as per claim 37, wherein said device layer is single crystal silicon

39. A micromirror device as per claim 38, said micromirror device further comprising:

active electronics formed on said substrate in said device layer.

40. A micromirror device as per claim 39, wherein said active electronics are connected to said actuation electrodes through a via post extending through said device layer and said sacrificial layer.

41. A micromirror device as per claim 37, wherein said mirror comprises:

a central mirror plate;

a concentric suspension ring connected to said central mirror plate;

a frame formed from said device layer in said mirror region; and

wherein said mirror is connected to said frame via flexures, said flexures comprise a first set of flexures connected between said central mirror plate and said concentric suspension ring and a second set of orthogonally oriented flexures connected between said concentric suspension ring and said frame.

42. A micromirror device as per claim 41, wherein said central mirror plate has a coating of reflective material thereon.